

The dimensions (in centimetres) of the specimens are:—

| | |
|---|------|
| Height of anterior lobe of ilium | 7·0 |
| Height of the proximal end of the pubis | 6·0 |
| Width of the proximal end of the pubis (from within outwards) | 2·7 |
| Greatest width of the acetabular cavity (from within outwards) | 3·7 |
| Length of the femur, so far as preserved | 31·5 |
| Diameter of the middle of the shaft of the femur | 3·6 |
| Width of the anterior face of vertebral centrum | 4·0 |
| Height of the anterior face of vertebral centrum | 4·0 |

LVII.—*On the Life-history of Dasyhelea obscura, Winnertz (Diptera, Nematocera, Ceratopogonidæ), with some Remarks on the Parasites and Hereditary Bacterian Symbiont of this Midge.* By D. KEILIN, Sc.D., Beit Memorial Research Fellow (Quick Laboratory, University of Cambridge).

[Plates XIX. & XX.]

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I. HABITAT OF THE LARVA OF *DASYHELEA OBSCURA*.

Dasyhelea obscura, Winnertz, is a very common midge, the early stages of which are almost always found in the decomposed sap filling the wounds of elm trees. The material which was used for the present study was obtained from a wound of an elm tree standing on the Caius College ground at Newnham (Cambridge) and facing Church Rate Walk. In addition to *Dasyhelea* larvæ, the decomposed sap of this wound contained the larvæ and pupæ of several other Diptera: (1) *Rhyphus fenestralis*, Scop., (2) *Mycetobia*

pallipes, Meig., (3) *Systemus adpropinquans*, Loew., (4) *S. scholtzii*, Loew., (5) *Aulacogaster rufitarsis*, Meig., (6) *Phaonia cincta*, Zett., and (7) an undetermined Syrphid larvæ closely allied to the genus *Ceria*. This wound was also visited by the predaceous larvæ of two Staphylinidæ*—one belonging probably to the genus *Quedius* sp. (subfamily Staphylininæ), the other being possibly a *Thamiaræa* sp. (subfamily Aleocharinæ).

Finally, the whole surface of the decomposed sap of this wound, and especially its solidified portions, was covered by myriads of a mite, *Hericia hericia*, Kramer (Tyroglyphidæ), in all the stages of its development.

The larvæ of *Dasyhelea* were also common in a similar wound of a horse-chestnut tree standing on the ground between the School of Agriculture and the Downing College grounds, and Mr. W. F. Edwards has kindly communicated to me the following unpublished records concerning the various breeding-places of this midge:—

(1) J. E. Collin bred it with *Culicoides varius*, Winnertz, and *Culicoides fascipennis* from débris of a chestnut tree (Suailwell, Cambs).

(2) F. Jenkinson reared them from elm sap (Logie, Elgin and Cambridge).

(3) F. W. Edwards himself obtained *D. obscura*: (a) with *Rhyphus fenestralis* from the decaying roots of *Angelica* (Knebworth, Herts), (b) from running sap of an oak, (c) with *Mycetobia pallipes*, *Systemus* sp., and an undetermined Syrphid from running sap of hornbeam, and, finally, (d) with *Rhyphus fenestralis* and *Mycetobia* from stagnant water in a hole in an oak tree (Epping Forest).

To find the early stages of *Dasyhelea obscura* it is sufficient to collect a small quantity of semifluid exudate filling the wound of an elm tree, to stir it in a petrie-dish with a little tap water, and leave it for an hour or more to settle. Examined under the binocular microscope, the eggs, larvæ, and pupæ of *Dasyhelea* are very easily detected on the bottom of the dish.

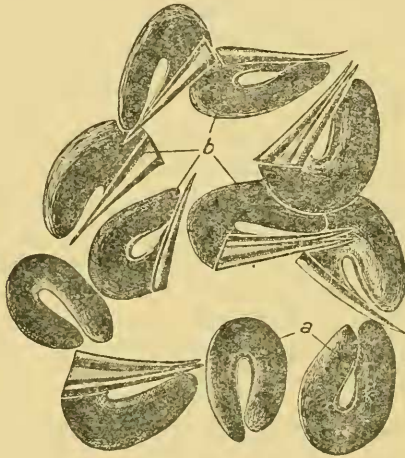
II. EGGS AND OVIPOSITION. (Pl. XIX. fig. 4, and text-fig. 1.)

The female seems to oviposit only once in her life, and the eggs, about 120 in number, are laid simultaneously upon the solid particles sticking out from the exudate or upon the moistened edges of the wound.

* The identification of these larvæ I owe to the kindness of Mr. K. G. Blair of the British Museum.

Each egg is surrounded by a gelatinous layer, and they are all embedded in a common gelatinous mass, somewhat similar to that of various Chironomids or Rhyphids (*Rhyphus* and *Mycetobia*). The egg is of a very dark brown colour and of a peculiar shape, which to my knowledge has not yet been encountered in any other insect. It is of elongate oval shape, $500\ \mu$ long and $75\ \mu$ in diameter, and sharply bent in its middle so that its two branches come almost into contact. The embryo and the young larva have the same curvature as the egg. When the larva hatches, the egg is split at one end, corresponding to the anterior and dorsal side of the enclosed larva, and the two edges of the split roll up externally, leaving a triangular opening through which the larva escapes.

Text-fig. 1.



A small portion of an egg-mass of *Dasyhelea obscura*, showing the eggs (*a*) before and (*b*) after the hatching of the larvæ; the gelatinous mass covering the eggs is not represented in the figure.

III. LARVA.

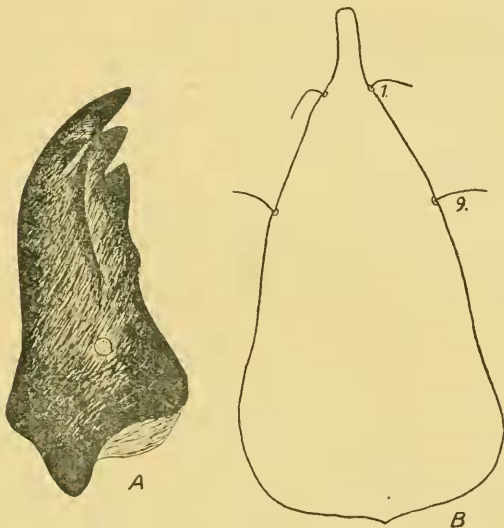
The larva when it hatches from the egg is 0.7 mm. long; it grows, undergoing several moults, and when ready to pupate it reaches 4 to 5 mm. in length and 0.2 to 0.3 mm. in diameter. The movements of the larva are very slow; it does not swim, and, when immersed in water, it crawls very slowly on the bottom of the dish, bending and unbending its body. The latter is composed of a head, 3 thoracic and 8 abdominal segments, the last abdominal segment being double (Pl. XIX. fig. 8).

(a) *The Head.*

The head of the larva is of a dark brown colour, triangular in shape, $330\ \mu$ long and $175\ \mu$ wide in its basal portion (Pl. XIX. fig. 1). Examined from the dorsal side, it shows clearly the suture which marks the dorsal plate or clypeus, which, in the skin cast at the moults, is very easily separated from the rest of the head, and then shows two pairs of short sensory hairs emerging from the edges of its anterior portion (text-fig. 2, B, *i* and *g*). The head bears a definite number (14 pairs) of sensory hairs and pits, the distribution of which is shown in fig. 1 (Pl. XIX.).

The *eyes* are heavily pigmented and crescent-shaped.

Text-fig. 2.



A, mandibule of the larva of *D. obscura*; B, its clypeus.

The *antennæ* (*a* and Pl. XIX. fig. 5) are very small and situated near the anterior end of the head; they are composed of a basilar segment bearing a special sensory organ corresponding to the bell-shaped papillæ of the antennæ of many other Dipterous larvæ. The basal segment shows, moreover, a short protuberance provided with four cylindrical papillæ.

The *labrum*, which follows the clypeal plate, is very short. Its dorsal side (Pl. XX. fig. 10) shows a pair of sensory hairs and a pair of sensory circular pits. The ventral side is of a more complicated structure (Pl. XIX. fig. 2); it is provided

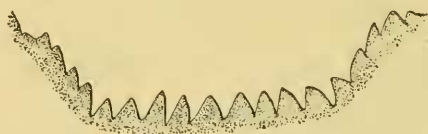
with 4 pairs of sensory circular papillæ, followed by 3 pairs of ordinary sensory hairs, one pair of pectinate hairs, one pair of short conical papillæ, one single median transparent papilla, and, finally, a median soft protuberance covered with short chitinous hairs. Viewed by transparency the labrum shows also a strongly chitinized structure, which serves for the attachment of the labral muscles.

The *maxillæ* (Pl. XIX. fig. 3) are very flattened and reduced almost to a group of sensory organs, comprising (a) a circular papilla, (b) a sensory hair, (c) a pit with 3 to 4 cylindrical papillæ, followed by (d) an ordinary circular papillæ and (e) a protrusible vesicle bearing 3 to 4 small papillæ.

The *mandibles* (text-fig. 2, A, and Pl. XIX. fig. 1, m.) are very strongly chitinized and provided with 4 teeth, 3 of which are clearly visible from the side.

The *labium* (text-fig. 3) has the form of a chitinous plate ending in 17 to 19 teeth.

Text-fig. 3.



Dasyhelea obscura: labium of the larva, seen ventrally.

The *hypopharynx* is very well seen by transmitted light as a very dark transverse chitinous sclerite occupying the central portion of the head capsule (Pl. XIX. fig. 1, h.). Its structure is much more complicated than was described by Goetghebuer (1914, p. 182, pl. ii. fig. 2) in a closely-allied species of *Dasyhelea*. It does not form one solid chitinous plate as represented by this author, but is composed of the following four independent sclerites (Pl. XIX. figs. 6 & 7):— (1) A ventral triangular plate (*v.*) with its lateral edges strongly chitinized and showing two ventral projections: one near the base of the triangle and another near the anterior angle of it, against the opening of the common duct (*s.*) of the salivary glands. The basal portion of the ventral sclerite forms a striated ridge (*r.*) from which originate numerous brown setæ directed backwards. The surface of this sclerite when examined ventrally shows four successive zones: (*a*) clear zone which receives the salivary duct, (*b*) an uniformly pigmented zone, (*c*) finely granulated zone, and (*d*) a more roughly granulated zone.

(2) The dorsal sclerite (*d.*) is very strongly chitinized and of almost quadrangular shape; it also bears posteriorly a

series of long setæ of brown colour, which in places are superposed with the setæ of the ventral sclerite.

(3, 4) Two lateral wing-like sclerites (*l.*) are articulated with the dorsal sclerite and serve for attachment of well-developed muscles. They are not evenly chitinized, and show clear and dark patches of chitin. The whole structure is connected with labium by means of two forked chitinous rods (*rd.*), which lie in the lateral walls of the buccal cavity. It is difficult to say, at present, if all the above-described sclerites form the hypopharynx, or if the latter is formed only by the ventral plate. This can only be settled by a comparative study of this structure in several other species of *Dasyhelea* and the closely-allied genera like *Culicoides* and *Forcipomyia*.

(b) *The Thorax.*

The thorax is composed of 3 segments of brownish colour; the latter is due to the brown granules filling the peripheral fat body-cells which line the hypodermis; clear unpigmented spaces remain only in the areas occupied by the imaginal discs of wings, halteres, and legs. The segments are furnished with a series of sensory hairs and pits, among which special attention must be given to the 6 groups of ventral sensory organs representing the remains of the thoracic legs of Dipterous larvæ. Each sensory group (Pl. XX. fig. 16) is composed of two long hairs and 2 pits connected with the imaginal discs of thoracic legs.

(c) *The Abdomen.*

The 7 first abdominal segments show a brownish coloration, due to the underlying fat body-cells, which, being more or less regularly distributed, produce a pigmented pattern characteristic of this larva (Pl. XX. fig. 9). These segments bear also a few sensory hairs and pits. The last abdominal segment is double; its anterior portion differs very little from the previous 7 abdominal segments, while its posterior portion has a very characteristic structure, which will be described below. It bears posteriorly the anus and a series of strong chitinous hooks bent anteriorly. Eight of these hooks, disposed in 2 groups of 4, are ventral (Pl. XX. fig. 13), while 2 pairs of similar hooks are dorsal in position (Pl. XX. fig. 12). Two small conical soft papillæ are seen among the hooks on the ventral sides. Laterally and close to its anterior boundary this segment shows two transverse elliptical transparent prominences (Pl. XX. fig. 11, *p.*). The space between the large hooks show a few rows of small dark hooklets or spines bent anteriorly. By pressing a

living larva between the slide and a cover-glass, four bifid transparent papillæ make their appearance from the anal opening. When completely everted from the larval body these papillæ are seen to arise in pairs from two large transparent vesicular bodies (Pl. XX. fig. 14). These protrusible papillæ (*rg.*) are homologous with the rectal gills of other Chironomid larvæ. In most cases when the larvæ are under observation, the rectal gills and the 6 pairs of hooks are retracted inside the body of the larva.

(d) *Internal Organs.*

Alimentary Canal.—The pharynx is followed by the œsophagus, which in the 3rd thoracic segment enters the proventriculus. The mid-gut is a straight cylindrical tube. The two pairs of Malpighian tubes arise at the junction of mid- and hind-gut, the anterior pair being long while the posterior pair is short. There is no intestinal cœca. The salivary glands are well developed and extend from the 2nd thoracic to the 6th abdominal segment. The cells of these glands sometimes show in their protoplasm needle-shaped crystals, the nature of which I was unable to determine.

The *nerve system* is composed of cerebral ganglia and 10 pairs of ganglia of the ventral chain, the last being double and composed of two pairs (10th and 11th) fused together.

The *respiratory system* is apneustic, with the tracheæ and especially the peripheral thoracic and the rectal well developed. The remains of the 10 pairs of non-functional spiracles are connected with the main tracheal trunks by means of 10 pairs of filaments without any lumen. The vestiges of spiracles are found in the pro- and metathoracic and in the 8 abdominal segments.

The *fat-body*, in addition to the peripheral sub-hypodermic pigmented cells, comprises two longitudinal perivisceral bodies devoid of brownish excretory granules.

IV. PUPA.

The pupa is completely free from the larval cuticle. It is 2.3 mm. long and of a brown colour. It becomes dark, almost black, when the imago is almost completely formed, but this coloration is due to the early pigmentation of the hairs of the imago seen through the transparent cuticle of the pupa.

The main characters of the pupa, which are of taxonomic value, are shown in figs. 15 to 21 (Pl. XX.). Each wing of the pupa bears near its terminal portion a small knob-like protuberance (*p.w.*, fig. 15, Pl. XX.). Two pairs of legs are

superposing one above the other, while the third pair (*l.* 3) is curved and lies beneath the wings.

The respiratory tubes or horns (Pl. XX. fig. 15, *p.h.*, and fig. 21) show numerous scale-like triangular plates and bear from 21 to 22 respiratory papillæ. The abdominal segments are divided, each by a row of dark strongly chitintzed hooks and plates, into two portions, anterior and posterior (Pl. XX. fig. 19). The hooks grow in size near the lateral sides of the segments, and become flattened and almost scale-like near the dorsal and ventral median lines. Each hook or scale bears a sensory hair arising from a small circular pit (Pl. XX. figs. 17 & 18). In front of the row of hooks the dorsal side of each abdominal segment shows 2 more or less chitinized spots and, more laterally, 2 short sensory papillæ.

The whole surface of the abdominal segments is covered with short hooklets or scale-like projections.

The last abdominal segment shows ventrally a longitudinal split and dorsally four pairs of strongly chitinized papillæ, two of which are provided with sensory hairs (Pl. XX. fig. 20).

The pupal stage is of a very short duration—six or seven days only.

V. LARVÆ OF OTHER SPECIES OF *DASYHELEA*, RECORDED BY VARIOUS AUTHORS.

The genus *Dasyhelea* is composed of several species, some of which are difficult to identify as there still remains some confusion about their nomenclature.

Mr. F. W. Edwards, of the British Museum, has kindly supplied me with the following list and synonymy of a few species of *Dasyhelea*, the early stages of which have been recorded and in some cases described:—

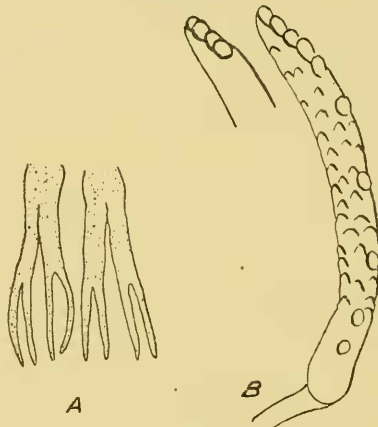
1. *Dasyhelea flavifrons*, Guérin, 1833.
2. *Dasyhelea dufouri*, Laboulbène, 1869.
3. *Dasyhelea hippocastani*, Mik, 1888.
4. *Dasyhelea obscura*, Winnertz, 1852.
D. homocera, Kieffer, 1919.
5. *Dasyhelea obscura*, var. *goetghebueri*, Kieffer.
D. versicolor, Goetghebuer, 1914 and 1920.
D. goetghebueri, Kieffer, 1919.
D. brevitibialis, Goetghebuer, 1919.
6. *D. versicolor*, Winnertz, 1852.
D. sensualis, Kieffer, 1919.
D. bilineata, Goetghebuer, 1920.
7. *Dasyhelea halophila*, Kieffer, 1911.
8. *Dasyhelea coarctata*, Kieffer, 1913, 1914.
9. *Dasyhelea diplosis*, Kieffer, 1913, 1914.
10. *Dasyhelea longipalpis*, Kieffer, 1913.

1. *Dasyhelea flavifrons*, Guérin, 1833.

This midge was bred by Guérin from pupæ found in the decomposed sap of an elm tree (in Paris). In his paper he gives a figure of the pupa (pl. viii. fig. 2, *e*), which unfortunately does not convey a single character of taxonomic importance.

The same species was also bred by Dr. Sharp from beech-tree sap in the New Forest, and by F. W. Edwards from horse-chestnut tree sap at Sidmouth. Through the kindness of Mr. F. W. Edwards, I was able to examine a few larvæ and pupæ of this species, and to compare them with those of *D. obscura*, Winnertz. The character of the larva of

Text-fig. 4.



Dasyhelea flavifrons: A, rectal gills; B, respiratory prothoracic horns.

D. flavifrons which enables one to differentiate it most readily from *D. obscura* is in the structure of its rectal gills. As text-fig. 4, A, shows, the 8 terminal branches in *D. flavifrons* are much longer than those in *D. obscura* (cf. Pl. XX. fig. 14). The prothoracic horns of the pupa in *D. flavifrons* (text-fig. 4, B) each bear only 13 spiracular papillæ instead of 21–22, as is the case in *D. obscura*.

2. *Dasyhelea dufouri*, Laboulbène, 1869.

The larvæ and pupæ of this species were discovered by Laboulbène (1869) in the thick sap filling the wounds of elm trees in Paris: his descriptions of larva and pupa are, however, very incomplete, and do not contain any characters of use in the identification of this species.

3. *Dasyhelea hippocastani*, Mik, 1888.

This species was reared by Mik (1888) from larvæ and pupæ found in ulcerating wounds of *Æsculus hippocastanum*. Unfortunately the larvæ and pupæ are very insufficiently described and figured.

4. *Dasyhelea obscura*, Winnertz, 1852.

The eggs, larvæ, and pupæ of this species are for the first time described in the present paper.

5. *Dasyhelea obscura*, var. *goetghebueri*, Kieffer.

According to F. W. Edwards, the larvæ and pupæ of this species were described by Goetghebuer (1914) under the name of *Culicoides versicolor*, Winnertz. From Goetghebuer's description and figures it appears that the larvæ and pupæ of this species differ in many respects from those of *D. obscura*.

- (a) The number of post-abdominal hooks of the larva in Goetghebuer's species is 14, while in *D. obscura* there are only 12.
- (b) The rectal gills are more elongated and of a type similar to those of *D. flavifrons* (cf. text-fig. 13).
- (c) The prothoracic horns of the pupa show the scales only in their middle portion, and the number of papillæ is reduced to about 12, while in *D. obscura* it is 21 to 22.

These differences show that the species described by Goetghebuer under the name of *C. versicolor* cannot be regarded as a mere variety of *obscura*, but has to be separated as a new species; it would be better to reserve for it the specific name of *D. goetghebueri*, already given to it by Kieffer (1919).

6. *Dasyhelea versicolor*, Winnertz, 1852.

This midge has been reared by Miss Stow from humus surrounding the roots of *Spiræa ulmaria* (Grantham, Lincs), and by F. W. Edwards from the scum on the surface of an aquarium (Hitchin, Herts). The pupæ of this species which I have received from Mr. F. W. Edwards differ very little from those of *D. obscura*. All I can say at present is that the few pupæ of *D. versicolor* which I have examined are more strongly chitinized, that the 3 medio-dorsal spots of the abdominal segments are more prominent, and that the scales and hooks covering the abdominal segments are more developed than is the case in the pupæ of *D. obscura*.

7. *Dasyhelea halophila*, Kieffer, 1911.

This species represents the type of the genus *Dasyhelea*. The larvæ and pupæ of this midge were for the first time found and described by Rhode (1912, pp. 24–26, quoted by Rieth, 1915). According to Rieth (1915) the larvæ and pupæ of *D. halophila* were found by Prof. Stener-Insbruck in a rock-pool at Manera Bay near Ragozuica (Sabenico), and also in rock-pools at Scoglio Mulo. The larva is 5 to 6 mm. long; the head is of a light brown colour and is about twice as long as broad; the post-abdominal hooks are brown and only slightly curved. The pupa is 4 to 5 mm. long; the prothoracic horns are covered with triangular plates. The forked post-abdominal protrusions are bifurcated (see his text-figs. : 46, 48–50, 52, 53, 62, & 64).

8. *Dasyhelea coarctata*, Kieffer, 1913–1914.

According to Rieth (1915) the larva of this species was found by Dr. Martin Hasper in a river at Monte San Bernardo, near Lûgano. The larva is 6 to 7 mm. long and similar to that of *halophila*. The pupa is 5 to 6 mm. long.

9. *Dasyhelea diplosis*, Kieffer, 1913, 1914.

According to Rieth (1915) the larvæ and pupæ of this midge were found by A. Thiemmann in Westfalia, in incredibly high numbers between the filamentous Algæ.

The salt content of this water varied from 7.219 g. to 13.485 g. per l., and at the end of May the pupæ of this fly were found in another pool with salt content 61.83 g. per l. The larva and pupa of *D. diplosis* have been described and figured by Rieth (1915, figs. 45, 47, 51, 54, 61, 63, & 65, A). The larva is 6 to 7 mm. long, white and opaque; the post-abdominal hooks are transparent, short, and markedly curved. The head is long, only one and a half times the width. The pupa is 5 to 6 mm. long; the respiratory prothoracic horns are devoid of scales, but are annulated along two-thirds of their posterior portion. The forked protrusions of the last abdominal segment of the pupa are short and simple.

10. *Dasyhelea longipalpis*, Kieffer, 1913.

According to Rieth (1915) the larvæ and pupæ of this species were found by R. Schmidt upon the filamentous Algæ in a pool containing salt water. Similar pupæ were found by N. von Hofstern in Mästermyre, in Gotland Island, and in the pools of Hörstel (with salt content 28.890 per l.).

The pupæ of this species (see Rieth, pp. 424-425 and figs. 60 & 65) are 3 to 4 mm. long; the prothoracic horns are ribbon-like and throughout their length show a spiral structure. The post-abdominal forked protrusions are short and simple.

Finally, it can be added that several species of *Dasyhelea* have been reared by Carter, Ingram, and Macfie (1920) in the Gold Coast, Africa, from the rot-holes in various trees, "such as the flamboyant, the silk cotton, the mango, a species of *Cynometra*, etc. . . . from partly decomposed roots or bases of banana stumps, and from the rotted wood at the sides and ends of canoes" (p. 202). The larvæ and pupæ observed by these authors still await description, but from the account of their behaviour it follows that they are very similar to those of *Dasyhelea obscura*.

VI. PREDACEOUS DIPTEROUS LARVÆ LIVING UPON THE LARVÆ AND PUPÆ OF *DASYHELEA OBSCURA*.

The larvæ and pupæ of *D. obscura* are destroyed in great numbers by the three following species of carnivorous Dipterous larvæ:—

1. *Phaonia cincta*, Zett. (Anthomyidæ, see Keilin, 1917, pp. 362-375).
2. *Systemus adpropinquans*, Loew (Dolichopodidæ).
3. *Systemus scholtzii*, Loew (Dolichopodidæ).

VII. PARASITES OF *DASYHELEA* LARVÆ.

The following is the list of the parasites which I have found in the larvæ of *D. obscura*:—

Fungi.

1. *Monosporella unicuspidata*, Keilin, 1920.—A parasitic yeast invading the whole body-cavity of the larvæ and destroying them before they succeed in pupating. The parasite is characterized by having the asci with only one acicular spore. There is only one other species of this genus: *M. bicuspidata*, Metchnikoff, discovered by Metchnikoff (1884) in *Daphnia magna*.

Sporozoa.

2. *Allantocystis dasyhelei*, Keilin, 1920.—An intestinal gregarine with elongated sausage-shaped cysts, living in the mid-gut of the larva between the peritrophic membrane and intestinal epithelium. This gregarine does not seem fatal to its host.

3. *Microsporidia*.--The alimentary tube and the salivary glands of the larvæ are sometimes invaded with a microsporidian parasite, which will be dealt with separately. This parasite destroys the epithelial cells of the organs, and appears to kill the larvæ before they succeed to pupate.

4. *Helicosporidium parasiticum*, Keilin, 1921, represents a completely new type of Protist which invades the fat-body, nerve-ganglia, and body-cavity of the larvæ. This parasite is very pathogenic and destroys a good number of *Dasyhelea* larvæ.

5. The perivisceral fat-body of the larva on two occasions showed the presence of a parasitic body resembling the trophic stage of a gregarine. This parasite will be described separately.

Nematoda.

6. In a few cases the larva of *Dasyhelea* contained a female of a nematode worm lying in the body-cavity. This nematode, of which I only know the females, seems to belong to the family of Mermithidæ.

VIII. HEREDITARY BACTERIAN SYMBIONT OF *DASYHELEA OBSCURA*, WINNERTZ.

All the larvæ of *Dasyhelea obscura* contain in their thorax four large bodies completely filled with bacteria. These four masses of bacteria grow with the larva and pass into the pupa and the adult fly. They are then transmitted to the eggs, and the small larvæ which hatch from the eggs already show the four bodies with bacteria in the perivisceral cavity of their thoracic segments. The complete account of this hereditary bacterian symbiont will be given in a separate paper.

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X. EXPLANATION OF THE PLATES.

[All the figures concern *Dasyhelea obscura*, Winnertz.]

PLATE XIX.

- Fig.* 1. Head of a full-grown larva, seen from the side: *an.*, antennæ; *cl.*, clypeus; *h.*, hypopharynx; *l.*, labium; *M.*, maxillæ; *m.*, mandibles; *s.*, duct of salivary glands; *1-14*, fourteen pairs of sensory organs.
- Fig.* 2. Labrum, seen from the ventral side.
- Fig.* 3. Maxilla, seen from the side.
- Fig.* 4. Egg taken out of the uterus of the ♀, showing the gelatinous layer with small chitinous rods surrounding it.
- Fig.* 5. Antenna of the larva.
- Fig.* 6. Hypopharynx, seen ventrally: *l.*, lateral wing-like processes; *v.*, posterior ridge of the ventral plate; *rd.*, lateral bifurcated rods connecting the hypopharynx with the labium; *s.*, salivary duct; *v.*, ventral plate.
- Fig.* 7. Hypopharynx, seen laterally: *d.*, dorsal plate; *o.*, œsophagus; other letters as in fig. 6.
- Fig.* 8. Larva, full-grown, seen laterally.

PLATE XX.

- Fig.* 9. Abdominal segments of the larva, showing the characteristic pigmented pattern.
- Fig.* 10. Labrum, seen dorsally.
- Fig.* 11. Posterior end of the larva, seen laterally, showing the hooks, *h.*, and the lateral protuberance, *p.*
- Fig.* 12. Posterior end of the larva, seen dorsally, showing 2 pairs of hooks.
- Fig.* 13. Posterior end of the larva, seen ventrally, showing 4 pairs of hooks.

- Fig. 14.* Posterior segment of the larva, showing the protruded rectal gills, *r.g.*
Fig. 15. Anterior portion of the pupa, seen ventrally: *l.3*, the third pair of legs; *p.h.*, prothoracic respiratory horns; *p.w.*, terminal protuberance of the wings.
Fig. 16. Sensory vestigial remains of thoracic legs of the larva.
Figs. 17 & 18. Abdominal hooks, with sensory hairs of the pupa.
Fig. 19. Abdominal segments of the pupa, seen dorsally.
Fig. 20. Posterior abdominal segment of the pupa.
Fig. 21. Respiratory prothoracic horns, showing the spiracular papillæ.

LVIII.—*Some undescribed Rhopalocera from Mesopotamia and N.W. Persia ; and other Notes.* By N. D. RILEY.

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THE following notes are based on the very rich material brought from Mesopotamia and N.W. Persia by Lt.-Col. H. D. Peile, I.M.S., F.E.S. Col. Peile is to be congratulated highly on the excellent condition of the specimens, the fullness of the data, and on the number of species obtained, often under conditions not at all conducive to entomological enthusiasm. The Museum also is greatly indebted to him for the generosity with which he has presented not only the types of all the forms, but also "as many as we want of everything else."

Col. Peile hopes shortly to publish in the Journal of the Bombay Nat. Hist. Soc. a fuller account of the *Rhopalocera* of the regions in which he collected, and to figure the majority of the new forms. Fuller particulars as to dates and localities, &c., will be found therein. Only those specimens of the species mentioned below, which have been incorporated in the General Collection of the Museum, are referred to here.

Pieridæ.

1. *Euchloë ausonia persica*, Verity.

Rhop. Pal. p. 178 (1908).

7 ♂, 7 ♀, Fathah, R. Tigris, 19-30. iii. 1920.

Verity says of his type specimen: "La tache apicale, peu étendue, mais très noire et à limites très nettes, rappelle plutôt celle de *belemia*, tandis que le trait discoidal très réduit, très droit et aussi éloigné de la côte que chez *falloui*,